AMERICAN
RAILROAD JOURNAL,
AND
MECHANICS' MAGAZINE.

No. 12, Vol. V. New Series. | DECEMBER 15, 1840. | Whole No. 372. Vol. XI.

At the close of another half yearly volume, in accordance with our usual practice we propose to address a few words to our readers in reference to what has been accomplished during the last six months, both in matters of general interest, and in those things which more particularly concern our readers and ourselves.

The latter half of the year 1840 will ever be remembered as a period of unusual political excitement, and hence unfavorable to any thing like clear and calm scientific inquiry. The depressed state of financial affairs throughout the country has continued to exert an unfavorable effect upon public works—although an improvement has been witnessed which appears to warrant hopes of still brighter times; consequently but little of novelty has been offered in the way of construction. Under all these disadvantages we have endeavored to present our readers with matters of interest and to improve the character of our work. How we have succeeded our subscribers can best determine.

The increased interest attached to the progress of ocean steam navigation has been the chief topic both in our own and foreign journals. The success of the two lines established between this port and England, and the more recent establishment of Cunard's line of mail steamers has called forth a variety of projects and a still greater variety of discussions, the latter, we regret to say, have not been the means of spreading any new light. The strict investigation of the power of steam and its application, is the only method of attaining any useful result, and of showing how much power is really lost in the necessary arrangements of machinery, by friction and otherwise.

The return of the President, caused by a deficient supply of fuel, has proved that her actual consumption of fuel is nearly if not quite ten tons per diem more than that the usual estimate, being an increase of more than 30 per cent. as her nominal consumption.

The recent surprising success of the Archimedes steamer in England has revived the prospect of the introduction of screw propellers. More experiments are necessary, however, to establish their superiority to paddle wheels.

The improvement of locomotive engines has continued to excite attention, and frequent notices of extraordinary performances appear. It is desirable that these experiments should be conducted with greater accuracy and precision than formerly, if designed to make any impression upon professional men. The quantity of fuel consumed is seldom or ever alluded to, although one of the most important items of railroad economy. When well made engines are so nearly equal in power as they now are, it requires very nice experiments to determine which are the best.

The recent order from the Emperor of Russia for a number of locomotive engines, and the building a steam frigate for the same power, in New York, shows how high the character of American mechanics stands abroad.

To those of our friends and correspondents who have contributed to our pages we return our warmest thanks, and by leave to remind them and others that the greatest service they can render the profession, is to communicate the results of their experience.

In conclusion, we have only to say, that if supported by our subscribers and contributors, we shall be able to increase the value and variety of our articles.

VENTILATION OF COACHES AND RAILROAD CARS.

Every little while we find some hints upon this subject thrown out in various journals, but they appear to receive as little attention as the reiterated complaints of the want of ventilation in public buildings. It is really wonderful that so little is cared for an abundant supply of pure air; in fact most people seem to be perfectly ignorant of any necessity for it, and consequently express provision is hardly ever made for that which is as necessary to the lungs as pure and wholesome meat and drink for the stomach.

The season is now at hand when in most railroad cars, stoves are provided for the comfort of the passengers. The consequence is that the temperature, already nearly if not quite sufficient from the quantity of animal heat generated, is raised to an uncomfortable degree, which the vitiation of the air by twenty to sixty lungs increased by the presence of the stove, until the atmosphere becomes positively deleterious. The doors and windows which in summer are left open, are most carefully closed, and not the least opportunity is afforded for introducing a fresh supply of air. We speak feelingly of this nuisance for we travel 22 miles daily on a railroad, and our partiality for fresh *unbreathed* air, is continually shocked by an atmosphere not only uncomfortable, but positively offensive.

The remedy for this nuisance is so simple that it is surprising that it is not universally adopted. The motion of the cars is sufficient to produce

a free circulation if the least aperture is afforded for the entrance and exit of the air. All that is necessary to be provided for is the dispersion of the cold air in its entrance in such a manner as to prevent the whole current from directly striking upon any particular seat. This can easily be accomplished by an attention to the principle that a current of air rushing into an atmosphere at rest is mixed with and dispersed through it with a rapidity proportional to the velocity of the current. A gentle draught of cold air entering a room is felt at a greater distance than a much stronger current of equal temperature, and consequently by a diminished aperture a sufficiently small current can be admitted of great velocity and so rapidly scattering as to produce no uncomfortable feelings at a short distance.

The method then of ventilating cars in the simplest manner would be to furnish a small opening in the front of the car near the top, and a similar opening directly opposite in the back end of the car. These openings should be covered with wire gauze to prevent the entrance of sparks, and provided on the outside with a shed water to keep out rain. It is plain that the air entering with such velocity at the top of the car is almost instantly mixed with the atmosphere within, while a corresponding quantity of heated and impure air escapes at the back of the car. In a long car, it would be better to provide two or more pipes ending at different places along the top of the apartment. The necessity for separate pipes will be evident, for no air would issue from any openings in the side of a pipe passing directly through the car.

We hope that the simple nature of the arrangement, which can be accommodated to all varieties of circumstances, will induce those having the control of railroads to provide for the comfort and health of passengers. The quantity of fresh air absolutely necessary to be supplied to each individual is four cubic feet per minute, and all that is short of this is as positively injurious as if the air had been poisoned by so much vapor of burning charcoal. An apartment containing 20 persons will need at least 80 cubic feet per second, and one containing 50 persons will require 200 cubic feet to be admitted each minute to maintain an atmosphere fit to support life without discomfort.

For the American Rrailroad Journal and Mechanics' Magazine.

REMARKS ON THE "LAWS OF TRADE." By C. Ellet, Jr., *Civil Engineer*. No. 4.

It has been demonstrated* that the charge for toll corresponding with the maximum revenue on the trade of any tributary of a canal or railroad, is equal to half the charge which, if exacted, would entirely exclude the article in question from the line; and that its expression for that division of the trade which is not contended for by rival works, is

$$C = \frac{\Pi - h\delta}{2h}.$$

* "Essay on the Laws of Trade," page 77—86.

and that the revenue per mile which will be obtained when that charge is levied, will be represented by

$$R = t\frac{(\Pi - h\,\delta)^2}{4\,\beta\,h}$$

By comparing these equations, and cancelling the numerators of the fractions, there will result

$$R = t\frac{C^2 h}{\beta}. \qquad \text{(K)}$$

for the value of the maximum revenue per mile derived from the trade of the branch in question, in terms of the toll, the distance, the productiveness of the country, and the cost of conveyance on the branch which furnishes the trade. It appears from this equation, of which the application is remarkably easy, that the profit due to the trade will be as the square of the charge for toll which would produce the greatest revenue, and consequently as the square of that charge which would just exclude the trade. The rule for its determination will be, *multiply together the number of tons furnished by each mile of the branch, the distance in miles from the branch to the mart, and the square of half the charge for toll which would exclude the trade, and divide by the cost of carriage per ton per mile on the branch.*

If the commodity under consideration were one for which a rival work were in competition, it would be shown by the same process that the revenue would be obtained by dividing the above product by twice the charge for conveyance on the branch.

For an application of the formula, let us suppose that it is ascertained that the annual quantity of any article produced along the Ohio is 50 tons per mile; that the main line of the Pennsylvania improvement is 400 miles long, and that the state of the markets, and other circumstances influencing the direction of the trade, are such, that if a toll of 4 cents per ton per mile were charged, the article in question would be excluded and forced down the river to New Orleans;—the charge for freight on the river being one cent per ton per mile. In this case the value of C, or the toll, ought to be two cents per ton per mile, and consequently the revenue would be

$$R = t\frac{C^2\,h}{2\,\beta} = 400 \text{ dollars}$$

per mile, or $160,000 per annum for the whole line.

It is true that there are few cases in which all the data of such a problem as this could be ascertained with sufficient accuracy to permit a very correct estimate of the probable revenue; but if we do presume to attempt to make such an estimate of the future proceeds of an improvement which is about to be constructed, by applying the rule to every article which the line is expected to accommodate, with the best data we can procure, the result will be the nearest the truth of any which we can deduce, and, withal, not unworthy of confidence. But, if it were otherwise, the equation would still be susceptible of useful applications. It teaches that the revenue is

directly as the square of the charge for toll which could be levied without excluding the trade; and, consequently, if we put C′ for this toll, and δ for any increase or diminution of the charge for freight—both being referred to the ton per mile—the charge for toll which the article will then bear will be

$$C' \pm \delta;$$

the positive sign being used when the freight is diminished, and the negative when it is increased.

Now, if R represent the revenue obtained before the increase or diminution of the price of freight, we shall have

$$R' = R\left(\frac{C' \pm \delta}{C'}\right)^2 \qquad \text{(L)}$$

for the revenue after the change shall have occurred.

We may apply this expression for the purpose of forming some estimate of the control which transporting companies have it in their power to exercise over the great lines of improvement of the country, which are maintained by the States, if they choose to form combinations for the regulation of the charges. If, for instance, the State of Pennsylvania, which is so situated, should find that a toll of three cents per ton per mile would exclude the whole of any article produced on the Ohio; and, after regulating the tariff in reference to that condition of things, should obtain from the commodity a revenue of one hundred thousand dollars; and the transporters should then think proper to increase the freight one cent per ton per mile, the Commonwealth would obtain a revenue of

$$R' = 100{,}000\left(\frac{3-1}{3}\right)^2,$$

or \$44,444. In consequence of an increase of freight of one cent per ton per mile, the revenue would, in this example, be reduced from \$100,000 down to \$44,444.

We could not, in the application of equation (K.) obtain all the data—as the value of t and β — with sufficient precision to predict with certainty a revenue of \$100,000, which we have supposed to be received; but after being taught by experiment the value of the revenue before the increase of the transporters charge, we can anticipate, with all desirable precision, the effect of that increase on the dividend. For this purpose we make use of equation (L) where those quantities of which the value is doubtful do not appear. In fact, it may be asserted as a rule, that whatever be the difficulty experienced in attempting to predict the amount of freight, or the revenue, which will be obtained by an improvement under known charges,—after experience has determined this point, we can always anticipate with great precision the revenue which will be received under any modification of the tariff. And this is all that is necessary to enable a company to operate with the greatest attainable advantage.

Errata.—In consequence of our not receiving the revised proof of Mr. Ellet's third article on the "Laws of Trade," until after the sheet was printed, several typographical errors escaped detection. Among them we

observe the word "investigate" for "integrate," "tare" for "charge," etc.—Eds. R. R. J.

For the American Railroad Journal and Mechanics' Magazine.

THEORY OF THE CRANK.

If Mr. Roebling will *re*-examine *carefully* the illustration given in the July No. of the Railroad Journal upon this subject, (pp. 36, 37, 38,) he will perceive probably that he has not given to that article sufficient attention.

Mr. R. will not, it is presumed, deny that the power acts with a certain leverage at *every point* in the quadrant. The *number* of the levers can, therefore, only be *truly* represented, geometrically, by the *arc of the quadrant*, AB or its *equal*, the line a b. (See the diagrams in the July number above referred to.) If from the several points in this line, perpendiculars or ordinates are erected equal in length to the *actual* leverage at the corresponding points in the curve, the whole will together form a surface, the *area* of which is the *sum* of *all the levers*. If this sum or area is divided by the number of levers, that is by ab, or AB, the quotient is evidently the *mean leverage*.

The mistake into which Mr. Roebling has fallen, consists in his taking the semidiameter AD to represent the number of levers instead of the arc of the quadrant AB.

Mr. R. will we trust see the propriety of withdrawing his accusation against the writer of the article referred to, of having "substituted a straight motion for a circular motion of the crank pin," and having represented "a circular motion as taking place in a straight line."

The straight line a b, to which he refers is made equal to the arc of the quadrant AB, and is so assumed for the purpose *solely* of illustrating the *geometrical* mode of arriving at the sum or number of all the levers. *No motion is assumed or "represented" as taking place along the line a b. That* line represents simply the space passed over by the crank pin, and is used in the demonstration for no other purpose but as a measure of that space or of the whole number of levers of which that space is the true and only exponent. "FULTON."

For the American Railroad Journal and Mechanics' Magazine.

INTERNAL IMPROVEMENTS OF NEW YORK. PROPOSED PLAN FOR PROSECUTING THE RAILWAY SYSTEM IN THE STATE OF NEW YORK.

I. The State to subscribe for and own one-third of the capital stock in all railways hereafter to be constructed within the limits of the State; the subscription not to be made by the State until satisfactory evidence is produced of the subscription by responsible persons or any municipal corporation, of the remaining two thirds of the capital stock, and the organization of a company in due form, and on evidence also that the capital assumed is sufficient, or nearly so, for the construction of the proposed road. In the payment of instalments, a similar rule to be observed. The payments made by the State to be made subsequent to those made by individual

stockholders, and on evidence that the latter has been *actually expended* in the construction of the road.

II. The surveys for the *final location* of any railway to be made under the direction of the engineer of the company, in conjunction with a commissioner appointed by the State for the purpose, and no location to be definite until it has received the assent of a majority of the directors and been approved by the Chancellor or some one of the judicial tribunals of the State. *Preliminary* surveys of railroad routes may be made as heretofore by the State under *special* acts for that purpose, and where surveys have been made by and at the expense of individuals, prior to the formation of a company, and from which valuable information has been derived, the expense thereof to be refunded by the company.

III. The State to be at the expense of obtaining the right of way for all railroads, and the ground thus taken to remain the property of the State, the use of which is to be guaranteed to the railway corporation during the period of its existence. The negociations for obtaining the right of way to be made by the commissioner above named, and the appraisements for the same purpose to be made under his direction. The commissioner to receive a per diem allowance for his services, and his duties to cease when the award of the appraisers for the whole line of the road has been rendered. The appraisers to be composed of three competent and disinterested persons to be named by the Chancellor of the State, one of whom shall be the judge or supervisor or clerk of the county in which the lands to be appraised are situated, and of the remaining two, one shall be a practical farmer and the other a practical railroad engineer.

The appraisers to receive a per diem allowance for their services to be paid by the State.

IV. All railroads to be built with the view of transporting both passengers and freight; and in the construction and operation of any railroad the company to be subject to such regulations as the legislature may from time to time think proper by law to prescribe.

V. The mails to be conveyed upon all railroads at such rates or upon such terms as the companies owning the roads shall prescribe, or as any three disinterested persons appointed by the chancellor of the state shall deem to be fair and equitable. The railways together with the cars, engines and superintendents, and operatives connected therewith, to be at all times at the service of the General and and State governments, for the transport of troops, munitions of war, conveyance of expresses, &c. and in the event of a disagreement as to the compensation which any company is to receive, the same is to be left to the decision of three disinterested persons appoint- as above by the Chancellor of the State.

VI. The State not to receive any dividends on its portion of the capital stock in any railroad until the private stockholders get five per cent. and to receive all above that amount until the dividend on its portion amounts to three per cent. Whenever any dividend exceeds five per cent. on two-

thirds of the capital stock, and three per cent. on the remaining one-third, the surplus to be distributed equally upon all the stock.

VII. Railway companies already organized. whose roads are completed or in progress, which may wish to be embraced in the plan here proposed are to be particularly designated in the act passed for the purpose, and such as have received loans of the credit of the State, are to be entitled to have those loans converted into subscriptions to the capital stock and the interest already paid by them to be refunded.

VIII. The railway companies are to make semi-annual returns to the secretary of State of their expenditures and receipts, viz.: on the first days of November and May, of each year, to be accompanied with a general statement of their proceedings during the intermediate time. The returns and statements thus made to be approved by a commissioner appointed by the legislature, who is to have free access to all the books and accounts of every railway company. The commissioners to be two in number for the whole State, to receive a fixed salary for their services, and to make *alternate* examinations of the affairs of the several railroad companies in the State.

IX. The act for carrying into effect the plan here proposed, to authorise the formation of railroad companies, and to define the mode of accomplishing their organization, without resort to the legislature, and to specify in detail all those restrictions and privileges, suited to the circumstances of the case and which are applicable to railroad companies generally.

No railway to be constructed running parallel with, and within a distance of twenty miles of any other railway already constructed or in progress unless authorised by a *special* act of of the legislature.

REMARKS.

The period has arrived, or is very near at hand, when the people of New York must determine whether the railroad system is to be prosecuted in the same manner with the canal system, by means solely of the money and power of the State, or whether some other plan shall be adopted, better suited to accomplish the object in view and more consonant with the genius and character of our political institutions. That railways are much better calculated than canals to accomplish the important object of a cheap, expeditious and uninterrupted intercommunication between the different sections of the country at all seasons, has now become apparent. Although sustained thus far by private enterprise and means, the system is rapidly gaining the ascendancy, as is evident from the fact that within the last ten years, 475 miles of railway have been put in operation in the State, while during that period only 182 miles of canal have been constructed, and the proportion of miles of railway now in progress compared with canals is as nine to one in favor of the former. Indeed, so much have the latter gone into disfavor that the last which have been undertaken would not have survived the embryo state but for the genial warmth of the hot bed of politics in which the germs were placed.

The conviction is indeed very general that the canal system, pushed as it has been to an extreme, must, so far as it regards the construction of any new works, be abandoned, and the grave question arises, whether in the prosecution of the better improvement of railways, the arm of the State is necessary to its success.

The view we have taken of the subject has brought us to the conclusion that, whether right or wrong in the abstract, the aid of the State *will be invoked* and *successfully* in support of railways, and it becomes therefore an object of importance to ascertain the best and safest and most effective mode by which that aid can be rendered. It is for the purpose of contributing our mite to the enlightenment of the public mind, that the foregoing plan is presented, and unless such a plan, or one similar to it, is adopted, the State must continue the practice already partially introduced of aiding railway companies by a loan of its credit, or otherwise railroads, like canals must be madeState works.

To both of these methods there are objections of a very serious character, which, to our mind, are conclusive as to the impropriety of their adoption. We hold the principle to be a sound one, that individuals cannot with profit or advantage to themselves or to the community undertake the construction of railroads, if, in so doing, they are obliged to rely on borrowed capital. Instances may occur in which such a course may be pursued with safety to the stockholders, but we imagine there are few capitalists who would embark in an undertaking under those circumstances, and the plan can never become sufficiently general to effect the great object of a well arranged system of internal improvement. It cannot indeed be effected successfully unless the State becomes the creditor or endorser, and in this case it becomes doubly objectionable. If the interest upon the loans made is promptly paid, and the company fulfil all its obligations in *good faith*, then they are little better off than they would be if dependent entirely upon loans from individuals, while the system is liable to great abuses in its tending to corrupt legislation, and the too great facility it affords to the dishonest and influential among the larger speculators of the day, to pervert the funds of the State to the promotion of their own private and selfish purposes.

As to the other alternative of making railways State works the experience we have had in respect to canals should prove a warning to avoid, while yet we may, the great dangers and evils of such a system. Although but fifteen years have elapsed since the Erie canal was opened, yet in that short period the people of this State have witnessed enough of wasteful expenditure and of sacrifice made at the shrine of politics, to cause them to ponder long before venturing into the hidden depths of a new system which from its peculiar character is fraught with evils of fargreater magnitude than the old.

* The plan of aiding by a *bonus* is not considered as among the plans which can by any possibility be adopted.

In the construction and management of canals, the works being complete, all that is subsequently required of the State is to furnish the necessary agents for attending to the repairs and collecting the tolls. Not so with railways; they are a species of improvement so widely different from canals, as to render their indiscriminate use by the public impracticable, and they must either be leased out to individuals or to companies to share the fate of all lease-hold property, or otherwise maintained and operated by the State. The number of agents and operatives required in the latter case, the great vigilance and care necessary to insure a harmonious action of all the parts, and the great increase in the expense caused by an injudicious or unfaithful attention to its affairs on the part of its officers and agents growing out of the complicated mechanical character of the improvement, the evident impropriety not to say absurdity of making the government which was instituted for higher and nobler purposes the common carrier for the conveyance of marketable commodities, all indicate most forcibly the unsuitableness of such a system for accomplishing the object designed. Even in an adjoining State where this plan has been adopted only in part, the railways being built and maintained, and the motive power furnished by the State, it is found to be attended with an increased expense, and of course less advantageous to the public than if owned and managed wholly by companies placed under suitable restrictions, while all the evils which are inseparable from State works growing out of the increase of State patronage, the temptations to use the public treasury by the party in power and the promise of it by the party out, to purchase popularity, the injury produced in consequence to the public morals, and the great danger which it threatens to our free institutions, remain in their full force, and in all their appalling deformity.

In New York, in particular, where from the extravagant schemes into which the State has already entered, it is hardly possible, even if no new obligations are incurred, to pass through the next seven years without resort to taxation or new loans to pay interest, it would be the height of impolicy to swell the amount of indebtedness to the extent which would inevitably take place upon the adoption of the principle, since out of the 1500 miles of railway completed and in progress in the State, two thirds or 1000 miles would immediately be thrown upon the State, causing a sudden and enormous expansion of the State debt to 30 or 50 millions.

That there is a propriety in appropriating some portion of the public funds to promote the object of internal improvements we have no doubt, this arises from the fact that in the construction of every public work a very large portion of the community are materially benefited by the increased value given to their property, who make little or no use of the work, and contribute, of course, little to its support. There are also many individuals, perhaps one third, on the line of every improvement, who are among those most benefitted, but who doggedly refuse to aid their more liberal and patriotic neighbors, from the belief that the work will be constructed

without *their* aid, and in the spirit of a true piratical stamp, are willing to reap the benefit of their neighbors enterprise without rendering therefor any equivalent. It is for this reason and also for the great advantage which railways are to the community generally in the conveyance of the mails, in contributing to the general defence, of which they will be found to constitute the most efficient arm, from the facilities they afford for concentrating troops and munitions of war at particular points upon any emergency, and their salutary influence in the prevention of monopolies, that we concede the propriety of bestowing upon them in the most unexceptionable manner possible, the aid of the State to a limited extent.

This aid we conceive may be rendered in the manner above proposed, so as to be attended with more benefit and with less objections than any other, which has come to our notice. Under a *general law,* like the one proposed, all *special* legislution together with its attendant expenses and the pernicious consequences flowing f om it in a moral and social point of view will be avoided. If, also, as in the plan proposed, individuals are required to contribute two thirds, of the capital needed, the State will not be as likely to be drawn into the construction of unprofitable or useless works. The propriety, not to say necessity, of adopting some plan for checking prodigal expenditure in this respect, must be apparent to any one conversant with the history of legislation in the several States where works of internal improvement have been constructed at public expense. It will, indeed, be impossible, under this plan, to appropriate the public funds as has heretofore been done in two many instances, to works devoid of merit, while at the same time, the system of internal improvements will advance with sufficient rapidity, and the best security be afforded of its being preserved in a sound and healthy state.

As it respects the location of railways the provisions contained in the plan appear to us to be particularly appropriate, for experience has shown that the duty of making a location cannot always be safely intrusted *exclusively* to a majority of a board of directors, many of whom perhaps have local interests to subserve which are adverse to those of the public and a large proportion of the stockholders. Experience has also shown the propriety of the method proposed in Sec. 3rd, for obtaining the *right* of *way.* In all railway charters thus far granted in New York, the provisions for this purpose are exceedingly onerous upon the companies, the benefits to the land proprietors not being allowed to be taken into consideration in the assessments for damages. Great expense has consequently been necessarily incurred in obtaining the right of way, amounting in some cases to $3,000 or $4,000 per mile, and in one instance to $7000 per mile, and in nearly every case the benefits accruing to the land intersected by the road were equal in the aggregate to the damage produced added to the value of the land taken. To obviate this great expense to which companies are unjustly subjected, the plan proposes that the ground should be taken and owned by the State. This course is also recommended for another reason. It puts at

rest the question of the right of the legislature to authorise the taking the property of individuals for the use of incorporated companies. A question, which so far as we have been informed has never been *definitely* settled, and in respect to which there exists doubts in the minds of those most skilled in expounding the constitution and laws of the State.

The advantages already described as accruing to the community generally from the construction of railroads, constitute a sufficient reason for devolving upon the State the expense of obtaining the right of way which from the mode of making appraisements, as hitherto pursued upon the State works, will not be heavy, while it will relieve the railway companies from a very great burthen. The same reason is also considered sufficient for withholding, as in Sec. 6, dividends upon the portion of stock held by the State, until the private stockholders realize five per cent.. This amount is considered sufficiently large to afford all necessary encouragement to individuals to become subscribers to the stock, while at the same time it is not so large as to constitute a satisfactory return to the stockholders for their capital invested, and induce them from any improper motives, by swelling the expenses, to keep down the surplus so as to exclude the State from a reasonable participation in the profits of the work.

There are other features of the plan, the propriety of which will, we think be obvious and will not therefore need to be particularly illustrated. Improvements may undoubtedly be made in the details, but in the general outline, it is believed to be the only mode in which the railway system can be placed upon a sound basis so as to produce the greatest good with the least expense and with the least evil resulting.

In adopting this plan the indebtedness of the State will not of necessity be greatly increased. Of the several railways in progress the two leading ones are the New York and Erie, and New York and Albany. To these may be added the Ogdensburg and Champlain which will probably soon be commenced. The cost of the first will not fall short of nine millions of of dollars. The credit of the State is already pledged to its support to the amount of one third of that sum or three millions.

The interest which has been paid on the part of this sum which has already come in possession of the company will need to be refunded or deducted from the succeeding payments, and the loan converted into a subscription to the stock which will aid very materially the efforts of that company without increasing the indebtedness of the State.

The amount required for the New York and Albany road will be about one million, and for the Northern road $700,000. There are some roads of lesser magnitude, such as the Saratoga and Whitehall, Syracuse and Oswego, Batavia and Buffalo, etc. which may require a million more. An increase of State debt then of only three millions of dollars, will be sufficient therefore to place the several works upon a stable and prosperous footing, and by extending the system to other works to which loans of the credit of the State have already been made, viz.: the Ithaca and Owego, Catskill and

Canajoharie, Auburn and Syracuse, Auburn and Rochester, Hudson and Berkshire and Long Island, converting these loans into subscriptions to the stock and repaying the interest, essential aid will be afforded to these important roads without materially increasing the State debt which will relieve them from present embarrassment, and place them in a condition of greater usefulness to the public.

The State of New York has thus far been content to exert its energies and expend its resources upon canals. The limit of prudence in its expenditures upon these has for some time been exceeded, and the system, cancer-like, is advancing at no very moderate rate towards the more vital parts, and if not soon arrested may prove to the tax-paying portion of our citizens a curse instead of a blessing. Fortunately the railway system has attained a degree of perfection which will cause it to supercede the necessity for any more canals, and as no bad precedents have as yet been established, railways, having as yet in no instance been made State works, and as the opportunity is a favorable one for the State to extricate itself from a very dangerous position, and escape from the gulf in which it was about being plunged by its departure from sound principles, we hope those principles will be permitted to prevail, and that the experience of the past will prove a sufficient warning to future legislators not to involve the State in a system of internal improvements, having an inevitable tendency to impoverish the public treasury, and which is destructive to the morals of the people, and fraught with imminent dangers to our free institutions.

FULTON.

RAILROADS IN THE UITED STATES. By Chevalier De Gerstner.

(Cotinued from page 344.)

RAILROADS IN OHIO, INDIANA, MICHIGAN AND ILLINOIS.

Ohio has early embarked in a system of internal improvements; but following the example of the State of New York, has chosen canals to form the artificial lines of internal communication through this large State. Several railroads were long afterwards undertaken by private companies whom the State assists by guaranteeing loans to the amount of one-third the cost of the works. Passing through a flat country, and intended to accommodate only a small traffic, the railroads in Ohio are constructed on a cheap plan, but are nevertheless progressing very slowly, owing to the difficulty of providing the necessary funds. For the Ohio Railroad, which is to extended along the shore of Lake Erie, a width of track of seven feet has been adopted—the other railroads have the usual width of four feet eight and a half inches.

In *Indiana* the internal improvements are, like the canals in Ohio, undertaken at the expense of the State, and consist in a system of canals, turnpike roads, and one railroad, leading from the capitol of the State to the Ohio river. This railroad is constructed in a very permanent manner. Another along the northern boundary line of the State has been commenced by a company, but the works were afterwards suspended for want of capital.

Michigan, though one of the youngest States, will soon have all the settled parts of the country traversed by railroads, which are partly construct-

RAILROADS COMPLETED AND IN PROGRESS IN THE STATES OF OHIO, INDIANA, MICHIGAN, AND ILLINOIS.

No.	Name of railroad.	From and to where.	Opened. Year.	Opened. Miles.	No. of Miles. Besides graded.	No. of Miles. Not yet const r'd.	Totol length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion.	Total cost of road.	Cost per mile.
1	Mad River & Lake Erie,	Sandusky City to *Springfield*.	1838	15	30	85	130	plates $2\frac{1}{4} \times \frac{5}{8}$	1 locomot.	155,000	755,000	910,000	7,000
2	Little Miami,	Cincinnati to Springfield.			20	65	85	$2\frac{1}{2} \times \frac{3}{4}$		100,000	900,000	1,000,000	11,765
3	Monroeville & *Sandusky*	Monroeville to *Sandusky City*.	1838	15			15	$2\frac{1}{4} \times \frac{5}{8}$	horses	75,000	15,000	90,000	6,000
4	Cleveland and Newburg City.	Cleveland to Stone Quarries.	1838	6			6	wooden ribbon.	horses	18,140		18,140	3,023
5	Fairport and Painsville,	Fairport to Painsville.	1838	3			3		horses	22,000		22,000	7,333
6	Ohio,	Coneaut to Maumee Bay.			30	147	177	$2\frac{1}{2} \times \frac{3}{4}$		50,000	1,189,000	1,239,000	7,000
1	Madison & Indianapolis,	Madison to Indianapolis.	1839	20	30	40	90	rails 45 lbs.	2 locomot's	1,300,000	2,200,000	3,500,000	38,889
2	Buffalo & Mississippi,	Western to Eastern Boundary of the *State*.			10	146	156			75,000	1,225,000	1,300,000	8,333
1	Erie and Kalamazoo,*	Toledo to Adrian.	1836	33			33	plates $2\frac{1}{4} \times \frac{5}{8}$	2 "	281,000	19,000	300,000	9,091
2	Palmyra & Jacksonsburg	Palmyra to Jacksonburg.	1838	11	5	30	46	$2 \times \frac{1}{4}\frac{5}{8}$	horses	53,000	246,000	299,000	6,500
3	River Raisin and Lake Erie,	Monroe to Lake Erie.	1838	4			4	wooden ribbon.	horses	44,000		44,000	11,000
4	Detroit and Pontiac.	Detroit to Pontiac.	1839	18	7		25	$2\frac{1}{4} \times \frac{5}{8}$	1 locomot.	160,000	40,000	200,000	8,000
5	Shelby and Detroit,	Detroit to Utica.	1839	10		7	17	wooden ribbon.	horses	23,000	17,000	40,000	2,353
6	Ypsilanti & Tecumseh,	Ypsilanti to Tecumseh.			5	19	24			40,000	160,000	200,000	8,333
7	Detroit and Maumee.	Manhatten to Havre.			3		3			15,000	5,000	20,000	6,667
8	Central,†	Detroit to St. Joseph.	1839	38	30	128	196	$2\frac{1}{4} \times \frac{5}{8}$	5 locomot's	800,000	1,552,000	2,352,000	12,000
9	Southern,†	Monroe to New Buffalo.			50	139	189	$2\frac{1}{4} \times \frac{5}{8}$		420,000	1,659,000	2,079,000	11,000
10	Northern,†	Point Huron to Grand Haven.			10	$191\frac{1}{2}$	$101\frac{1}{2}$	$2\frac{1}{4} \times \frac{5}{8}$		60,000	1,955,000	2,015,000	10,000

* 12 miles of this railroad are in the State of Ohio. † These 3 railroads are *State* works.

RAILROADS IN OHIO, INDIANA, MICHIGAN, AND ILLINOIS.—Continued.

No.	Name of Railroad.	From and to where	Opened. Year.	Opened. Miles.	No. of miles. Besides graded.	No. of miles. Not yet constr'd.	Total length of road.	Weight or dimensions of iron rails or bars	Motive power used.	Amount of capital already expended.	Amount wanted for completion	Total cost of road.	Cost per mile.
1	Central,	Cairo to Galena.			85	65	450	$2\frac{1}{4}\times\frac{3}{4}$		400,00			
2	Northern Cross,	Quincy to State line of Ind'a.	1839	16	100	114	230	"		785,00			
3	Peoria and Warsaw,	Peoria to Warsaw.			24	92	116	"	2 locomot's	140,00			
4	Bloomington and Mackinaw,	Pekin to Bloomington.			10	$26\frac{1}{2}$	$36\frac{1}{2}$	"		75 00			
5	Southern Cross,	Alton to Mount Carmel.			30	117	147	"		150,000	14,007,500	15,768,000	12,000
6	Alton & Shawneetown,	South Cross to Shawneetown.			15	130	145	"		75,00			
7	Alton and Shelbyville.	Alton to Shelbyville			15	93	108	"		45,00			
8	Central Branch,	Shelbyv'le to State line of Ind			20	$51\frac{1}{2}$	$71\frac{1}{2}$	"		90,00			
9	Rushville and Erie,	Rushville to Erie.				10	10	"		500			
10	New Pittsburg & Miss.*	Illinois Town to Coal Mines.	1838	7			7	$2\times\frac{1}{2}$	horses	42,000		42,000	6000
11	Galena and Chicago Union,*	Galena to Central Railroad.			4	96	100			30,000	1,170,000	1,200,000	12,000
29				196	533	$2092\frac{1}{2}$	$2821\frac{1}{2}$		13 locomot's	[illegible] 23,64[illegible]	27,114,5[illegible]	32,638,1[illegible]	11,568

* These two railroads are constructed by companies; all the others are State works.

The following table gives a summary statement of the works in each of the four Western States.

Name of State.	No. of railroads.	No. miles in operation.	Total length of road	No. of locomotives.	Am't of capital expended.	Am't necessary for completion.	Total cost of railroads.	Average cost per mile.
Ohio,	6	39	416 miles.	1	$ 420,140	$2,859,000	$3,279,140	$ 7,883
Indiana,	2	20	246 "	2	1,375,000	3,425,000	4,800,000	19,512
Michigan,	10	114	$738\frac{1}{2}$ "	8	1,896,000	5,653,000	7,549,000	10,222
Illinois,	11	23	1421 "	2	1,832,500	15,177,500	17,010,000	11,970
	29	196	$8221\frac{1}{2}$ miles	13	$5,523,640	$27,114,500	$32 638,140	$11[illegible]68

ed by the State, and partly by private companies. The country is very favorable for the location of railroads, and they are therefore executed at a very moderate cost.

The system of railroads projected in *Illinois* is far too great for the present population, trade, and resources of this young State, and it will be long before all the railroads projected and under construction will be completed. Besides the State works, only two railroads have been undertaken by private companies, one of which has been completed; of the other, the works are suspended. The width of track of the railroads both in Michigan and Illinois, is four feet eight and a half inches.

The data for the following statement has been collected during the months of August and September, 1839, and as very little has been done from that time to the end of the year, the numbers have been left unaltered.

Of the 29 railroads in the States of Ohio, Indiana, Michigan, and Illinois, only 196 miles have been completed and put into operation; of these, 56 miles are used with horse power, and 140 miles with locomotive engines; each locomotive serves, therefore, for 11 miles of railroad. When all the railroads projected and commenced in the above four States will be completed, their aggregate length will be 2,821½ miles.

The total amount already expended on all the 29 railroads is $5,523,640, and near five times as much, or $27,114,500, will be required, according to the estimates, to complete the works; the total cost being estimated at $32,638,140, or only at $11,568 per mile at an average. This cost appears very low, compared with that of other railroads; but with the experience already acquired in the construction of these kind of works, and where the country offers so few obstacles to their location, there is no doubt that railroads with wooden superstructure and plate rails may be executed for the sum of $12,000 per mile.

☞ We have received a communication from Mr. WM. MC C. CUSHMAN, which will appear in our next number, it having been received too late far this one.

The Canal.—It affords us pleasure to be able to state that the work on the canal is now going on with much spirit—numerous hands are employed at the earth-work and the protection wall in front of the bluffs near this town; and we have the fullest confidence that the first mile, including the dam eighteen feet in height, across the Milwaukie river, will be completed within the next year. This will afford us an immense water power in the town, which will induce the building of large flouring mills, so much needed by the farmers, as affording a ready market for their produce, even the present season.—*Milwaukie Adv.*

ON SAFETY VALVES AND SAFETY PIPES.

Formerly, when a *condensing* engine was spoken of, it was always considered that a *low pressure* engine, either Newcomen's or Boulton and Watt's, and working at only two or three pounds above the pressure of the atmosphere, was the kind of engine meant. But of late years, since the Cornish fashion of first expanding and then condensing high pressure steam has come into use, the terms used are no longer convertible.

More recently, owing to the great improvements made in engineering tools and workmanship, Trevithick's high pressure non-condensing engine has been made in such perfection, that it is frequently capable of working well at a *lower* pressure than even the Boulton and Watt low pressure

engine is sometimes working at in the factory districts. Consequently there is some fear of a confusion of terms in those various designations, not perhaps when applied to the engines themselves, but with respect to their boilers. Thus, for instance, we sometimes see accounts in the newspapers of high-pressure boilers being *blown up* or exploded; and of the low-pressure boilers of condensing or factory engines only *bursting*, while the later may really have been working at a higher pressure than the former.

There are, however, one or two broad marks of distinction between the two classes of boilers, well known to all practical engineers, and terms expressive of those distinctions (*high* and *low* pressure) have grown into use from the original manner of working the two great classes of engines, Boulton and Watt's, and Trevithick's. These terms, we think ought to be adhered to, not only because they sufficiently indicate, to the public generally, the presence or absence of great danger, and correctly so when properly used, but also because it is probable that that portion of the working mechanics of this country usually entrusted with the care of steam engines will continue to adhere to what has been sanctioned by long usage.

High-pressure boilers are universally known in England to be generally circular or cylindrical, or some form closely approaching thereto, and with hemispherical ends, (technically called *egg* ends,) unless the boiler contains an inside flue, and then the ends are only segmental or slightly convex,—but in all cases made without sharp corners or acute angles, and with iron plate of sufficient thickness not to require any internal stays to strengthen it.

Low-pressure boilers are not limited to any particular form, but so contrived as to suit the place they have to stand in, or that form which is most convenient for applying the fire to the most considerable portion of their surface. And the more they differ from the circular or cylindrical form, the more they require internal stays to support them, not only against the internal pressure of the steam, but also against the external pressure of the atmosphere, in case the steam should at any time happen to fall below that pressure.

To provide against the partial vacuum which produces the last mentioned effect, low-pressure boilers are also usually supplied with an air valve, sometimes called an *internal safety valve.* It is a small valve opening inwards, and weighted with only a few ounces, so that should the steam fall ever so little below the external pressure, it opens and allows air to pass into the boiler.

On the contrary, the high-pressure boiler is supplied with an *external* safety-valve, weighted so as to blow off at a little above the pressure that the engine is calculated to work at, which should never be more than one-third of that which the boiler has deen proved to be able to sustain.

There ought, indeed, to be two safety valves, one locked up, loaded with the proper weight, and without the intervention of a lever; the other under the engineer' s control, with a lever and spring balance indicating upon a scale the pressure exerted upon the valve to confine the steam.

The great and leading distinction, however, as respects danger, between the high and low pressure boiler, is, that usually the former requires to be supplied with water by a force pump worked by the engine, and which injects a small quantity at every stroke against the elastic force of the steam; while on the other hand, the low pressure boiler is supplied by means of a *feed pipe* standing on the top of the boiler, and containing a column of water of sufficient weight to balance the pressure of the steam, the water in the boiler being constantly supplied so as to retain the proper altitude, from a small open-topped cistern on the top of the pipe, which cistern is kep

supplied either from the hot well by the engine or from any other source.

Now, as the feed-pipe of a low-pressure boiler is only required to be of sufficient length to hold such a head of water as will, by its hydrostatic weight or pressure, balance the greatest elastic force of the steam intended to work the engine, it is evident that as soon as this limit is exceeded, the water in the feed pipe will be liable to boil or prime over, and, consequently, under such circumstances, the boiler becomes as perfectly safe as any ordinary open-topped pan of the same height as the top of the feed cistern.

From the above description we see the inutility of a safety valve on a low pressure boiler, except for the purpose of blowing off the steam occasionally, and thereby preventing the inconvenience resulting from boiling over; and this is accomplished generally by means of a valve placed on the steam pipe leading from the boiler to the engine, so as to be at hand for the engineer to blow off when required, previous to stopping the engine.

Many people we know strongly recommend a safety valve to be placed on the boiler itself in addition to the ordinary blow valve of a low pressure boiler, but in the case of a boiler fitted up in the manner we have described, any one may perceive it would be perfectly useless, *and therefore, practically injurious.* In saying this, it is not of course, to be understood that any harm can accrue from an extra safety valve abstractedly considered, but only as it is a means of withdrawing attention from other more obvious means of safety. In this view of the subject the safety valve may be aptly compared to Sir Humphrey Davy's celebrated safety lamp for coal mines, of which it is frequently said, and we think truly, that for every life it has saved it has been the means of destroying twenty, by inducing a negligent attendance to improved systems of ventillation.

The common feed pipe of a boiler is, in fact, a *safety pipe*, and very much superior in all respects to any safety *valve* that can possibly be devised, the moveable column of water within the pipe answering the purpose of both valve and weight; and it is justly considered as a beautiful example of the general superiority and simplicity of using hydraulic means in accomplishing objects of this kind, over the ordinary mechanical contrivances. In the most improved arrangement for this purpose, (we allude to Mr. Elsworth's hydraulic joint for superceding the stuffing box of the buoy-rod,) if considered as a safety valve, there is this essential property, *it cannot be overloaded* or tampered with in any respect; besides, it is impossible for it to *stick* or get out of order, because it is continually on the move, and that without wasting any steam.

Until within the last two years there were probably 400 to 500 boilers working in Manchester without safety valves, but nine out of ten of them, at least, were fitted up with the common feed pipe as above described; yet the proportion of fatal accidents from explosions of boilers in Manchester are almost as nothing in comparison to the number that occur in steam boats, although, in the latter, the boilers are always supplied with at least one safety valve.

The fact is, that, both in high and low pressure, the chance of an explosion occurring is more dependent upon the mode in which the boiler is supplied with water than upon any thing else, and although the common feed pipe is not so applicable in steam boats as on land, yet a safety pipe acting on the same principle might be very easily applied, and would serve as an infallible check against the water getting too low as well as against the steam getting too high, if made with its lower end to terminate a little above the flues, so as to allow the steam to blow away whenever the surface of the water in the boiler descended below that point.

A patent safety pipe has, we understand, been tried in London, but it is

so contrived as to *put out the fire*, by boiling over into it, whenever the steam gets too high, which property would be perhaps in many cases an inconvenient addition, although not half so bad as an American safety pipe which has very recently been puffed through all the newspapers, and which is described as having the following curious property: *when the steam is too high it shuts the furnace door quite close, so as to make it impossible for the fireman to open it* to supply more fuel. Now if this patent contrivance had been made to act quite the reverse, or to have *opened* the furnace door as we do in England, instead of *shutting* it, the invention might have been useful; but as it is, it is much more calculated to cause explosions than to prevent them.

ON THE STEAM ENGINE.

(Cotinued from page 278.)

In a previous paper we quoted Mr. Palmer as stating the maximum effect that nature is capable of accomplishing to be 44,467,500 lbs. raised one foot high, with one bushel of best Newcastle coals, in the absence of all *friction*. And at the same time we stated that a Cornish pumping engine, in London, had performed a duty of 72,000,000 lbs. besides the accompanying *friction*. According to a later report, the same engine has performed 92,000,000 lbs. duty, besides friction—Welsh coals having been used, and the steam cut off at $\frac{1}{3}$ of the stroke; which latter circumstance we wish particularly noticed, as corresponding with our experience, and because we shall have to allude to it hereafter. It here appears that the *duty actually performed* by steam is more than double the utmost power that steam possesses, as Mr. Palmer understands and states it. How great then his error becomes, when the *friction* is added to the duty, which in the Cornish engines is frequently much more than the duty itself; and how clearly it appears that he did not know one quarter part so much of the true value of steam as the Cornish engineers whom he so presumptuously undertook to rebuke.

The friction of the Cornish single pumping engine has been treated by Mr. Wickstead as single also; now, although the action of steam, from its being confined to one stroke in these engines, is single, yet the friction extending alike to both strokes of the engine and the pumping machinery also, is double, and the joint amount truly enormous, from the great mass of matter to be moved, of which the timber pump-rods alone, 12 to 14 inches square, extend perpendicularly 700 to 800 feet or more, and in many instances to great distances horizontally. In none of the reports of duty by the Cornish engines are these important contingencies either described or alluded to with the attention they deserve or that is required for a due considertion of the subject, but are all indiscriminately merged into the comprehensive term "friction;" and this being doubled by the peculiar formation of the engine, is necessarily prodigious as it appears to be in Mr. Henwood's tables, in 2d vol. Journal Inst. Civil Engineers. Hence, the reported "duty" of these engines has been only the inadequate representative of a portion of their *power;* for it must be readily conceded that all power wasted or misapplied is as truly power as that usefully employed; and this latter portion alone has the duty hitherto truly represented.

The annexed table is abstracted from Mr. Henwood's lucid and valuable description of his careful experiments on the best engines in Cornwall. It will be seen that Watt's double condensing engine, an estimate by Professor Renwick of the loss of power of which we condemned in a formar paper as extravagant, and justly condemned as we shall hereafter prove, becomes by contrast with these in the table the very mirror of economy.

ABSTRACT FROM HENWOOD'S TABLES.

ENGINES.			HUEL-TOWAN. Cyl. bottom and cover steam cased	BINNER DOWNS. Cyl. & steam pipes heated with fire.	EAST-CRENNIS. Cyl. & steam pipes cov. with sawdust
Diameter of Cylinder.		in.	80	70	76
Diam. of Valves.	Steam.	in.	8	9	10
	Equilibrium.	in.	12	12	14
	Exhausting.	in.	16	1	16
Length of Stroke.	Cylinder.	ft.	10.00	10.00	10.25
	Pump.	ft.	8.00	7.50	7.16
Air Pump.	Diameter.	in.	36	33	26 two of
	Stroke.	ft.	4.0	4	4.5
Water in Boiler.		cub. ft.	1080	636	1920
Steam in Boiler.		cub. ft.	700	350	650
Temperature of Hot Well.		deg.	93.8	89.2	88.2
Temp. Condensing Water.		deg.	64.7	52.3	67.0
Area of Fire Grates.		sq. ft.	72.0	48.0	37.5
Surface exposed to action of Flame.		sq. ft.	114	76	57
Total heating Surface exposed.		sq. ft.	2600	1440	2500
Absolute Steam Pressure in Boilers per sq. inch.		lbs.	61.8	[illegible]4 7 / 58.0	36.8 / 26.3
Times Steam is expanded.			6/13	1/6 / 1/7	1/3 / 2/3
Absol. steam in cyl. per sq. in.		lbs.	27	26 / 25	25 / 21
Load per inch on area of Piston—Useful Effect.		lbs.	10.2	10.23 / 10.2	11.4 / 11.4
Friction—Loss of Power—Useless effect.		lbs.	16.8	15.7 / 14.[illegible]	13.6 / 9.6
Duration of Experiment.		hrs.	24½	25	22½
Coals consumed.			Bu.50= [illegible] 1	6[illegible]=50 1	3005 lbs.
Oil used.		Pts.	1	1	1
Grease used.		lbs.	20	15¼	17
No. strokes made by engine.			7,881	11,258	4,7[illegible]
Strokes per minute.			5.35	7.49	3.5
Duration of working stroke.		sec.	1.6	1.34	1.7
Duration of return stroke.		sec.	4.8	4.23	4.17
Interval between strokes.		sec.	1.8	2.4	11.2
Tons lifted 1 foot for 1 farth.			1085	1006	870
Duty in lbs. lifted 1 foot with 84 lbs. dry coal.			77,533,107	[illegible]4,395.[illegible]3	73,502,69

The tables from which the preceding is compiled contain very careful descriptions of important *facts*, to which we have added a column with the nearest vulgar fraction, denoting the quantity of steam expanded, and another column for the "friction," or power wasted or uselessly expended, to show at a glance, without trouble, the actual advantages or disadvantages of using steam of various densities.

Let us now compare these *facts* with a table and statements from Prof. Renwick's Treatise, p. 157.

"*Relative powers of an engine using the same quantity of fuel, and acting expansively at different tensions.*

Force in atmospheres.	In lbs	Cylinder filled.	Effective force
$1\frac{1}{6}$	17.5	wholly.	10.00
2	30.0	$\frac{1}{2}$	10.75
3	45.0	$\frac{1}{3}$	27.50
4	60.0	$\frac{1}{4}$	35.60
5	75.0	$\frac{1}{5}$	43.50
6	90.0	$\frac{1}{6}$	51.00

It will therefore appear, without any change in the general distribution and plan of an engine, provided the boiler be strong enough to bear the increased force of the steam, its power may be readily increased five fold.

Again (p. 158;) "This method has been brought to the test of actual experiment, in the pumping engines in the mines in Cornwall, and by its use the power of an engine of a certain nominal horse power has been increased five-fold."

Again (p. 160:) "In this way the force of steam has been gradually raised from little more than a single atmosphere to ten; and an intelligent Cornish engineer states he has seen it raised to 20 or 30 atmospheres."

Now it is most desirable and essential that this bold theoretic statement should be examined by competent persons, whose examination might confirm it if right, or disprove it if wrong, for the sake of the public weal—for the many individuals interested in such a multitude of respects—and for the national character, which cannot fail ultimately to be seriously affected by the currency of such opinions, and by the dangerous practice recommended from such an illustrious source.

Now if Professor Renwick is right, if this his statement is true, it is as evident as the sun at noonday, that the power of an engine using the same fuel and expanding the steam, may not only be readily increased five fold, but ten fold or more; because this plausible theory is altogether based and depends upon an unlimited gain being attainable from a limited cause—stripped of its learned disguise, it would be as unfounded, as were the opinions of those unfortunates seeking perpetual motion.

To prove the unsoundness of these views, as we may, and desire to do, without discussion, we have only to bring the theoretic statements into juxtaposition with Mr. Henwood's experiments, which in density of steam, and in times expanded, though all purely accidental coincidences, are as impartial and correct trials of the theory as could have been contrived by man.

Thus, then, the duty of the Binner-Down engine using steam of 75 lbs. elasticity, should have been 300 millions, or more than four times as great as the duty (73 millions) of the East-Crennis engine, using steam of 26lbs. elasticity. But the difference in the duty of these two engines, tried so carefully under circumstances all corresponding with the theoretic statement—with steam exactly corresponding with those prescribed, from which such great advantages are unhesitatingly promised—this difference of duty

instead of being as stated, 3 times the duty of the East-Crennis engine, appears less than the $\frac{1}{73}$ part thereof; and even this almost insensible quantity is probably the result of mere accident.

Hence, then, it has been satisfactorily and experimentally proved that steam of 75 lbs. per inch expanded, is of no greater value whatever than steam of 26 lbs. per inch used expansively; we are thus allowed the choice of only two opinions—either the learned theorist or the unlearned steam-engine must have been mistaken; and, hard though as it may be, we have no doubt this uncandid world will be far more ready to attribute the mistake to the former than to the latter, which from natural dulness and incapacity, will probably be pitied rather than blamed. But the theorist may even then amply console himself by reflecting, how difficult it is to find an engineer who is not just as much mistaken as himself on this particular subject, for the very construction of these Cornish engines, and their using steam of such different densities, evidently prove a seeking for some as yet undiscoverable advantage. If he wants farther consolation, let him observe the uncertainty that prevails in the construction of engines, scarcely any two being built alike—or the more brilliant example afforded by the splendid public experiments in which the United States government indulges, who from mere inability to discover the wonderful advantages anticipated in that most exquisite of all steamers, the Fulton, are building two more on different principles and at a venture, determining if possible to discover the hidden perfections of the first. Now we have shown in this paper that one of these second thoughts, the British marine engines is a poor affair to copy—in our next we will show the other is worse.

If he does not then receive full consolation, let him observe how readily and constantly in all countries is a plausible and lazy, if brilliant, fiction preferred to sober facts demanding study and serious attention. Were facts substituted for fiction in this matter, however trivial they may appear to a superficial and careless observer, it would soon be seen that on the proper application and appreciation of them such an immediate great and general improvement of the steam-engine would ensue, as in its various and total results can hardly be overstated by the most sanguine admirer of that mighty instrument of civilization.

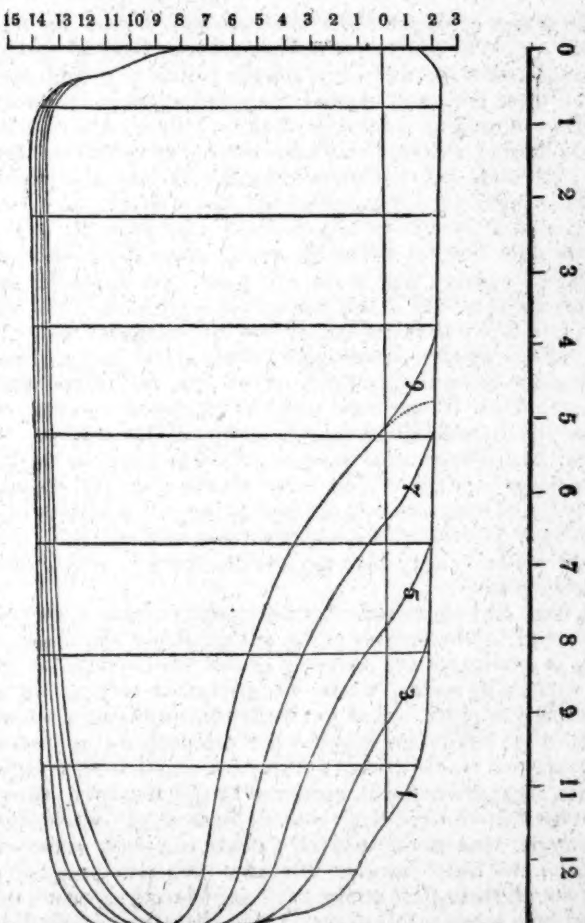
It is in continual shadow hunting that substantial truth is overlooked, and great and real advantages are disregarded; would engineers but condescend to examine and appreciate the true nature of expansive steam; would they but condescend to be satisfied with the great and real advantages it possesses—would engineers, (we ask not philosophers) condescend to disburthen or to cease from burthening expansive steam with useless conditions and pernicious and visionary restrictions, destructive of its usefulness, immense improvement would immediately ensue, and soon become general in the steam engine, which luckily never yet became a theorist, and therefore will ever and constantly be found obedient to reason.

Now we have shown, page 162 of this essay, that it is commonly a matter of great, if not perfect indifference, if from a given volume of water and heat whether high steam or low steam is formed and employed to produce motive power.

We have also shown, page 164, the value of gain from steam expanded is ever definite, and proportional to the density of the steam before its expansion. From these two positions it necessarily results, that whether proportional quantities of high or low steam be expanded to produce motive power, the superior quantity of the weaker expanded steam acting on a larger suface, will always compensate for the superior density, but lesser quantity of the denser steam acting on a lesser area; and these two distinct

actions of high and low expansive steam will be precisely equal, leaving for future consideration some disturbing forces not now pressing for immediate discussion, and which can be more satisfactorily treated hereafier. These equal actions, though so contrary to the current and popular opinions universally prevailing, are positive facts, necessarily arising from the definite nature of steam definitely expanded within a heated cylinder, and these its certain and invariable qualities are proved to the very letter, and as perfectly as the sagacity of man can devise, by Mr. Henwood's experiments on the Binner-Down and the East-Crennis engines; and just as plainly, fully, and satisfactorily are Professor Renwick's theoretical statements contradicted.

We shall attempt to establish an important and invaluable truth on the destruction of this extensive and dangerous error by which the utility of the steam engine has been much lessened, and happily we shall be just as able to produce undeniable facts in proof as we have already done for all our assertions; so that in every thing we are about to adduce, we shall be supported by indisputable evidence.



For this purpose we annex a fac simile of a diagram described by an indicator attached to one of the engines of the Great Western steam ship, and like the "handwriting on the wall," it greatly excels the handwriting of man. It gives a clear insight and full detail of the true internal state and power of the engine under varied circumstances, its capacity for improvement and even the acquirements of the manufacturing engineer—matters essential to be known and difficult to be otherwise determined. The diagram shows the steam as cut of by cams, (9) five of which are numbered and their effect ascertained, besides that of the slide movement. This engine is undeniably experimental, and the production of a mind seeking and not possessing information of the most essential character conceivable in a marine steam engine.

8)120.45

15.05
1.05 deduct for friction.

14.05 effective pressure per square inch.

On the proper application of steam evidently depend the form, dimensions, and weight of boilers, water, space and weight of machinery, the quantity and cost of fuel and labor, and the portion of freight usefully employed for those purposes. In fine, the speed, expense, and profit of steam navigation evidently as much depend on the proper application of steam, as this again must ever depend on a knowledge of its useful and definite properties. All these are vital matters in steam navigation on the ocean, and are in those engines much miscalculated, and evidently not yet understood.

The journal of the British Queen steam ship, page 50, vol. i. of this work, will show how far behind the age are these British marine engines; in a voyage occupying 450 hours the steam was expanded during 388 hours, at what is termed in this journal two-eigth stroke, but which from diagram now before us of that engine was three-sixteenth parts only, the remaining 62 hours mostly three-eighth parts of stroke, and of which only 18 hours extend to five-eighth stroke; and we have the fullest assurance the steam in the Great Western was no better employed, as the engines in that vessel are equally insufficient for a better application of steam.

The full and uninterrupted use of expansive steam, with its various advantages being impracticable in these vessels from the disproportion of their engines, is from necessity confined to the paltry purpose of saving an inconsiderable quantity of fuel in unfavorable weather alone. How effectually and profitably may these engines be improved, or how certainly and easily be surpassed.

Thus, then, may another shining light, another learned theorist be farther instructed by the mechanics he so ignorantly attempted to mislead when he so profoundly and learnedly proved the impossibility of navigating the Atlantic by steam; which we, mechanics only as we are, mere dust, are about to prove, has as yet, though so surprising to the intellectual doctor, been but tardily and imperfectly accomplished. A consideration of this diagram will render evident another and considerable advantage in the application of expansive steam, unnoticed by the visionary, unexpected by the practical, but which in large engines becomes of considerable amount by the superior vacuum obtained when steam is greatly expanded; for in this diagram the better vacuum increases the steam pressure when the steam is cut off at one-third stroke a full one-fifteenth part more than when compared with steam at full stroke; hence alone there is one-fifteenth part

additional power to be gained, which is now lost in these engines, in addition to that great gain from the employment of expansive steam.

But the great, the incalculable information contained in and derived from the diagram, is the full proof of that most desirable fact, that the full efficiency of steam is to be obtained from the expansion of low steam; hence we shall find the unlimited and inestimable advantages of steam may be obtained without its horrors and indescribable afflictions, and which are the more dreadful and disgraceful because the use of high steam is as unprofitable as inhuman.—*American Repertory.*

ADVANTAGES OF COMPRESSED PEAT. By Alexander S. Byrne.

(Continued from page 248.)

The preceding paper shows the value of peat in the manufacture of iron; but it may be profitably used for other important purposes.

Fuel.—It is of great value as fuel for furnaces and firing of every description, more especially so when coked and mixed with coal, or coal tar, or resin, pitch, and such like substances. Mr. Charles Williams, managing director to the Dublin Steam Navigation Company, a gentleman of experience and practical information, recommends a mixture of peat coke and resin for steam vessels. From his statement printed in the Transactions of Civil Engineers, London, it appears that one ton of resin fuel, (i. e. peat coke and resin) thrown in front of a coal fire is equal to three tons of coal.

For every description of firing, peat coke is invaluable. Its freedom from injurious and unpleasant exhalations, its durability and extreme brilliancy, are among its chief recommendations. What is so cheering as a brilliant fire! Of domestic comforts it is certainly one of the chief. For such purposes peat fires are unequaled. They are beautiful and pleasant, affording an *intense* heat, and a pure white and yellow flame, not surpassed by the finest coal.

Coking.—This is accomplished by means of heat. There are several modes of coking compressed peat: in every instance atmospheric air is excluded, and passages left for the volatile products to escape, as explained under the head *Pyroligneous Acid.* Some employ large brick chambers, with a hole at the top, a door at the side, and gutters at the bottom for the tar to escape: others form piles of various shapes, and cover them with loam, to screen the burning heap from a too free access of the atmosphere, which would otherwise consume it entirely. In some districts, large coking ovens are preferred; in others, a sort of iron hood; and in others, the use of large iron retorts. In every instance it is important that the process be conducted as uniformly as possible; that the escapes for tar and gaseous products be perfectly free; and that the mass undergoing carbonization be so distributed that the *whole* be acted on at the same time. Charcoal obtained by the action of rapid fire is always inferior to that obtained by slow calcination in pyramidal piles.

For softening steel plates, charcoal from turf moss is equal to the hardest oak; for the production of gunpowder, many varieties are superior to dogwood and alder, and for crayons it is equal to the finest willow. Much, however, depends on the mode in which it is burnt.

Gas.—Peat is very valuable for the production of gas. We have made considerable quantities in England and in Ireland. Prof. Maugham, of the Polytechnic Institution, London, one of the first practical chemists in that city, was induced to examine the subject, in consequence of our experiments in Ireland, and he has announced his opinion that peat may be so employed to considerable advantage. It has been severely and advantageously tested upon a large scale in Dublin, Paris, and Plymouth. Some

kinds of peat (top surface) yield three times as much gas as coal; but as a general rule it does not yield more than Wigan or New Castle coal: it is, however, far superior in brilliancy and power.

There was an objection to this gas, which for a considerable time destroyed all hope of rendering it useful, and severely injured the works erected for its production. In the distillation, an impalpable powder came over with the gas, which washing and re-washing would not remove, and it eventually deposited itself in the pipes and in the holes of the burners, and stopped them up. To remedy this evil, it occurred to us to use oil in the purifiers instead of water, which, we are happy to add, answered to the fullest extent. We have also found that oil acts as an excellent purifier for every kind of gas, and greatly improves its quality. The expense is trifling, as the oil when boiled becemes clear, and leaves all impurities at the bottom. Gas passed through *boiling* oil is still better. When mixed with coal in equal quantities, and calcined in the same retort, the peat at the bottom and coal on the top, the coke and gaseous products are superior to those obtained from the finest coal. The brilliant appearance of peat gas, and its *intense heat*, has been matter of surprise to those engaged in its production. Persons unacquainted with the secrets of a gas-work have urged as a reason against the use of peat gas, that it burns away in less time than gas from coal. In answer to this objection we would observe, that it is not true from a pure top-surface peat, but only of the lower beds; and being more brilliant, a less quantity will give as much light: also, that twice as much peat can be distilled in the same space of time; consequently, *twice as much coke can be obtained*, and at the same expense. Coke is considered *the most valuable* product in a gas-work.

Pyroligneous Acid.—When subjected to decomposition by fire, peat gives off condensible acetic vapors; its elements being separated by the action of heat, and reunited in another order, produce compounds which did not exist before. The proportions of these products differ in the same substances, according to the degree of heat applied, and the skill with which the operation has been conducted. The quantity of crude acid produced from turf-moss, and peat collected from the top surface, is very great.

For this purpose, the apparatus used in the manufacture of coal gas, or wood vinegar, may properly be employed. This consists of large air-tight cylinders, condensers, purifiers, stills, &c. The compressed peat, well crushed and broken, is to be put into retorts, their doors having been closed and luted with clay. Each door has a small vent, capable of being closed by a stopper or valve. The use of this vent is to allow the volatile products which are given off during calcination to escape; and the use of the stopper is to close the vent so soon as the calcining matter ceases to give out such vapors; or supposing, as is usual, another vent to be in the upper part of the retort, then it allows the operator to watch the process of calcination. Within each retort passes a rod, revolving upon its two extremities as points; the one end resting on the farther extremity of the retort, and the other in a hole in the stopper, capable of being closed by a cap. This rod has at one end a circular plate; and at equal distances along its length are fixed fans or spokes, perpendicular to the axis of the retort. The use of this apparatus is to stir and divide the matter while in calcination; and it does this when the stopper is removed, and a key is inserted into the rod, and turned round, causing of course the rod with its fans to revolve on its axis. The use of the round plate is, when the matter is perfectly calcined and the door is removed, to draw it forward, and rake it out with as little delay as possible into proper recipients placed in front.

The retorts should be heated to a pale cherry red before they are filled; and as soon as they are rendered air-tight by the closing of the doors, the process of decomposition begins, and the volatile products, consisting of gases, vegetable tar, and pyroligneous acid, being separated, pass off through an aperture in the top of a retort, to which pipes are attached, leading into condensers: these pipes are generally *wormed*, and inclosed by a stream of cold water. The gases may be purified, and collected in a gasometer to be burned, or turned off by means of a pipe into the fireplace. The condensed liquors are then allowed to settle; the vegetable tar falls to the botton, and the crude liquor is separated by decantation from the empyreumatic oil associated with it, and re-distilled in the ordinary way. The odor peculiar to this acid may be easily removed by agitating it with oil, and distilling it with sub-carbonate of potash and animal charcoal: or the vapors which pass over, during distillation, may be purified with greater effect by passing them through oil.

It is to be observed that the volatile matter which is allowed to escape during calcination is all valuable. The tar is useful as a varnish; or being subjected to distillation by itself, it affords crude pyro-acetic spirit, naphtha, kreosote, &c. The gases may be employed for illumination; and the crude acid may be employed for preparing acetate of iron, acetate of alumina, and acetate of lime (used in calico printing;) or it may be used for the production of pure acetic acid, and the best household vinegar. The charcoal which remains in the retort is superior to wood charcoal, and may be used as fuel.

Roads, Pavements, &c.—Peat does not answer alone for these purposes, being of a pulpy nature when wet, and too easily pulverized; but when combined with an artificial asphaltum, composed of carbonate of lime and coal tar, it forms a solid and elastic road, superior in many respects to wood or native asphaltum, and presenting a surface which in all seasons affords good footing for cattle. The tendency of this artificial asphaltum to crack and break is counteracted by the strong fibre of the turf, which, if added to the chalk and tar while warm, acts as a *binder* when the mass is cooled, and obviates its brittleness. In this respect peat is analogous to hair in mortar.

For Cabinet and Ornamental work, it is only necessary to use the peat when warm. It may then be moulded to any form, and afterwards hardened in alum water, varnished, or covered with metalic solution, to render it impervious to water. When properly compressed, it can be worked in the same manner as wood, and is capable of sustaining a very high polish.

Having said so much on the properties and uses of peat in compressed and other states, we would remark, in conclusion, that where density is not a considerable object, peat can be advantageously worked in good brick machines, provided the superabundant water is evaporated, and the operation completed, while the peat is warm.

We sincerely hope that these observations may induce our friends in Ireland to provide suitable employment for the laboring poor of that country, and that her desolate moors may soon become, as was once said of them, "mines above ground."—*American Repertory.*

The Thames Tunnel.—The famous Thames tunnel, as is well known, is now near completion. The mode of egress, for foot passengers, is to be a spiral staircase. The carriage way is to be spiral, and two hundred feet in diameter. The gradients of the road will be about one foot in twenty-five, forming an inclination by no means inconveniently steep.

SIXTH SEMI-ANNUAL REPORT OF THE ENGINEER OF THE CENTRAL RAILROAD AND BANKING COMPANY OF GEORGIA, TO THE PRESIDENT AND STOCKHOLDERS.

In making the present semi-annual report of the operations of this department, and the condition of the work under its charge, I take great pleasure in announcing to the stockholders, the final and complete location of the road to the Ocmulgee river at Macon. The work has been one of great labor, and has occupied the time and exertions of a party of Engineers who have been engaged in the special service for nearly four years. The complex topography of the country through which the upper portion of the line runs, and the various routes that presented claims to an examination, have rendered these protracted and laborious surveys indispensable.

Four different routes have been surveyed between the Oconee and Ocmulgee rivers; and each successive survey has shown a line improved on the previous one; and it is confidently believed we have at length selected one that could not be much further improved. We have been able to keep our planes within the maximum inclination of 30 feet per mile, and have no curves on a shorter radius than 2000 feet.

The excavation and embankment are reduced to a much smaller quantity than we at first even hoped for; and the character of the material for the most part, is such as to allow its removal without the aid of the pick or even the plough. Pine timber of the best quality, abounds throughout the whole route, and although we shall encounter no rock in our excavation, it can be obtained at reasonable distances from the points where it will be required for masonry.

To the untiring perseverance, good judgment, and scientific qualifications of my principal assistant, Mr. Franklin P. Holcomb, I take pleasure in ascribing the credit which is eminently due him, for the selection of so favorable a route; his duties have always been performed with cheerfulness, and in the most thorough manner. His labors have been faithfully seconded by the several gentlemen composing his party, who have also just claims to my approbation.

In my previous reports, I have described the route to the Oconee river; it will be borne in mind that the line approaches the Oconee by the valley of Sandhill creek. This creek joins with Buffalo creek, as it enters the Oconee swamp, and our line in passing through the river swamp on the east side, crosses several lagoons and branches of Buffalo creek. The distance from the high ground to the river, is little short of a mile. This is the lowest part of the river swamp, and the road will be passed over it, on truss work, founded on piles, for about a distance of 4000 feet, to the bank of the river.

The width of the river at the time the line was located, was 140 feet, and the depth, in the deepest part, about 8 feet; this however was at its lowest stage. The plan adopted for the main bridge, is the lattice plan, invented by Mr. Town,—the length of the bridge two hundred and fifty feet, to be supported by two abutments and one pier, of stone; the bottom of the bridge will be elevated 22 feet above the surface of the water at its lowest stage, and the grade of the road will be five feet above the height of the great freshet in June last. On the west side of the river, the swamp is about two miles in width; this will be crossed by an embankment, averaging about fifteen feet in height, with an opening near the middle of 1000 feet of truss work, making in all, a water-way of about one mile, to vent he water of the Oconee river.

It is a very fortunate circumstance, that we had such an indication as the last great freshet to guide us, in fixing the grades of our road across this river, and determining the character of the structure of that portion of the work. The celebrated Yazoo freshet, would otherwise have been taken as the high water mark and that did not reach the height of this last flood, by nearly five feet, at that point.

Having thus passed the Oconee river, we find ourselves near the mouth of Commissioner's creek, which discharges itself into the river about a mile and a half below our line*, about four miles from the river, the line crosses to the south side of the creek, and follows its valley for the distance of twenty-six miles; then leaving it we pass with a cut of thirty-one feet (which is the highest point of land the road crosses, being about 500 feet above tide water) into a prong of Big Sandy creek—following this stream, with a descending grade, about two miles, we cross it, and take another branch of the same creek, which we keep for about the same distance; thence across the main branch of Sandy creek; by a small branch we ascend to the summit between the Oconee and Ocmulgee rivers—here we have a short cut of thirty-two feet depth at the highest point; falling into a branch of Swift creek, which we follow a mile and a half, then cross the main creek; and taking and taking another branch of Swift creek, we reach Boggy branch, which leads us to the valley of the Ocmulgee. In crossing from Swift creek to Boggy branch, we encounter the deepest cutting on the line, which at its greatest depth is forty-one feet. After reaching the river valley, about three miles below the City of Macon, we keep along the low grounds, and enter the river swamp near the great mound; the line crosses the river, about half a mile below the bridge, and terminates on the flats at the foot of Cherry street in Macon,—the whole distance from this city being 190 miles, 3900 feet.

In the event of terminating the road on the east side of the river, we should deflect by a curve to the right, commencing near the mound; and run along parallel with the river, to such spot as might be selected for a depot.

For a distance of 25 miles from the Oconee swamp, the work is for the most part light, with occasional short cuts and fills; the remainder of the distance about 16 miles is rather heavy, compared with other parts of the line. I have taken the precaution to have wells dugs in the principal cuts, to ascertain the quality of the material to be excavated, and find it to be of the most favorable character. The cuts are composed of a mixture of sand and clay, easily removed by the shovel.

On the subject of the termination of the road at Macon I am of opinion that the interest of the company, and more especially that of the city of Macon, would be best promoted by crossing the river.

It appears to me that the free and constant intercourse which will necessarily be kept up by the business community, with the depot, requires the removal, as far as possible, of every obsticle to such intercourse; and that the intervention of the river, would be, in some degree, a hindrance to the transaction of business; but more especially in the event of the destruction of the present bridge by fire or otherwise. Should the road be carried across the river, the bridge would of course be so constructed as to be used exclusively for the passage of the trains, and would therefore be no injury to the present one, in the matter of travel. There will be no difficulty in selecting a favorable site for a depot in either case. The additional expense to the company by crossing will, be about $30,000.

The grading of the whole of the line not under contract is advertised for letting at Milledgeville, on the 5th day of next month; and I flatter myself that we shall have no difficulty in putting it under contract; should this be

done I think we shall be able to reach Macon with the superstructure by 1st January, 1843.

The work has progressed steadily on the grading contracts for the last six months; the total distance graded is now about 143 miles and the superstructure is completed 126 miles

The 2000 tons of iron last ordered, has all been received, and will be sufficient to extend the track to the distance of 139 miles. Our trains are now running regularly to Hardwick's, 122 miles from the city, and although the cotton crop has been unusually late, and very short, our business has been, during the last six months, nearly double the amount of the same period last year.

Receipts of the road for 12 *months, ending* 31*st Oct.* 1840.

Up freight.	Down freight.	Mail.	Passengers. No.	Passengers. Amount.	Total.
$44,425 09	$34,817 74	$3,792 32	11088	$30,792 36	$113,827 51

[The above is exclusive of the transportation of iron and other materials to a large amount, for the uses of the road.]

The expenses of the transportation department for the same time, have been	$23,276 16
Repairs of road,	$11,075 31
Total,	$34,351 47

The average distance in operation, during the past year being about one hundred and ten miles—the cost of repairs has therefore been about one hundred dollars per mile.

The opinion has generally prevailed, that a railroad, to be profitable to its stockholders, must have a large amount of travel—that the only source of profit is in the transportation of passengers, and that as a general rule, the freighting of heavy commodities, yields little or no profit to the company.

The experience thus far, on our road, demonstrates in the most satisfactory manner, the error of this opinion. It will be perceived by the above statement, that our freighting business has more than doubled the amount of that of passengers, and mail—and this has been done under the disadvantage of having but one train for both purposes, consequently keeping up a speed altogether too great for the most advantageous transportation of freight. I have no doubt that freight trains run separately from the passenger trains, with full loads, and at a velocity not exceeding ten miles per hour, would yield as much profit per trip, to the company, as passenger trains carrying fifty passengers each way.

The present terminus of our road, is by the wagon route, 70 miles from the city of Macon. Notwithstanding this long portage over a bad road, we have had, during the present season, nearly all the freight for that city. There has been an average of 200 wagons, running during the last three months to and from the depot. I am confident that the merchants will find it to their advantage to abandon altogether the steamboat business, on the Oconee and Ocmulgee rivers.

Our machinery and motive power department, is now as complete as the necessities of the road require. Since my last report, a locomotive engine, from the manufactory of Messrs Rogers, Ketchum and Grosvenor (the Oconee) has been added to our motive power, making our whole number eight. The superstructure of the road continues to maintain its grade and allignment, and the small amount expended in repairs, as before stated, has kept it in good repair. Some of the timbers first laid on the lower portion of

the line, have decayed, and we have, during the past year replaced them. Contracts have been made for the delivery of timber at different points along the oldest parts of the road, for the occasional renewal of such pieces as may be decayed.

The operations of the road have thus far been conducted *without the occurrence of a single accident resulting in personal injury to any one.*

Should we succeed in letting the grading, as we have reason to expect we shall, on the 5th of December we shall, be able to complete the road, without receiving aid from abroad in the way of pecuniary means. It will be a subject of just pride to the friends of the institution should an undertaking of such magnitude be carried through with their own resources, unaided by foreign capital. I take pleasure in congratulating them on the prospect of such a result.

Respectfully submitted,
L. O. Reynolds, Chief engineer.

Steam Navigation.—It is remarkable that this science, did not for many years after its invention and application, make such progress as one would conceive its palpable merits and advantages entitled it to. It was not until the year 1828 that the navy of England possessed a single steam vessel, and in 1835 we had only twenty one of the aggregate of 3000 horse-power. From that date this species of force has multiplied greatly, and now amounts to nearly eighty, under the pendant of 11,000 or 12,000 horse power. France has done her best to keep pace with us, having between forty and fifty steam vessels afloat and building, but none equipped of more than 220 horse power. By arming her packets she makes considerable display; but her resources for increasing this force on emergency are feeble as compared with our own, for the mercantile steam tonnage of the United Kingdom, progressing as it is in a prodigious ratio, presents the most stupendous element of naval power (by giving facility of operations) that the world has ever witnessed. We recollect when the expedition for the attack of Copenhagen was projected, in 1807—the completest and best appointed expedition that ever England sent forth—although preparations were commenced in March, it was not until so late in the season as the 26th of July that the first division of the fleet sailed from Yarmouth roads, leaving but little time to execute the objects of the campaign before the winter set in. Now, England at this moment possesses such an amount of steam tonnage, (according to the last official returns published 810 vessels, 157,840 tons, 63,350 horse power,) that a portion of it could convey the necessary troops, with all the usual appandages, and tow a squadron of ships-of-war to the scene of action, in less than one quarter of the time occupied in the former expedition, should circumstances ever render it necessary for us to occupy the island of Zealand, or any post in the Baltic. The fact is that steam navigation, not only as directly applied to vessels-of-war, but in aid of combined expeditions for sudden descents upon different points, enables the country possessing it in the greatest force to harass an enemy's coast with a small but well appointed army, and to carry destruction to every town and village within a dozen miles of the sea, unless they are regularly fortified and garrisoned, or covered by large bodies of troops. It is stated by an old author, that "in the year 1647 the Dutch with a fleet and but 400 men on board, alarmed the whole coast of France, and obliged the French king to keep near 100,000 men upon the maratime coast, as not knowing where they would fix."

If such was the case with vessels when movements were dependent on

winds and tides, and whose operations were under such circumstances necessarily slow, how much more so it will be with the aid of steam, when, by this means, vessels of light draught, heavily armed, not a boat will be permitted to pass out of gunshot of the shore, nor a harbor left open for egress or ingress any day in the year.—*London Naval and Military Gaz.*

Armed Steam Craft for the Lakes.—A correspondent of the Cleveland Herald, writing from Chippeway, U. C. says:

I have been permitted to visit Her Majesty's steamer, building at this place. She is called the *Minos*, in honor of the first King of Crete, who, according to heathen mythology, was after death promoted to the rank of *chief fireman* in the regions *de l Enfer!*

She is 148 feet on deck, and registers 400 tons, and is built in every respect a " man of war." She is of great strength, her timbers being placed close together, are caulked and pitched before planking, so that in the event of starting a butt, she would not leak; a very desirable object in armed vessels. On the inside, parallel bars of iron are let into the timbers the entire length of the boat, and placed six or eight inches apart. This does not add materially to her strength, but renders her almost shot proof. Her planks are five inches and her sealing three inches thick, making her entire thickness about twenty-two inches of solid timbers.

She is fitted with two 45 horse power low pressure beam engines, from the manufactury of the Messrs. Ward, Montreal, which are placed entirely below deck, on the plan of the Atlantic steamers, and are beyond the reach of external injury; but they are, in my opinion, of too small a calibre for so heavy a boat.

The engines are supported by iron frames resting upon large fore and aft timbers, placed on either side of the kelson, which are securely bolted and fastened to the deck frame of the boat, and will, instead of weakening the boat, add greatly to her strength. The cylinders are 26 inches in diameter, with four feet and a half stroke, placed upright in the usual manner, but in place of one working beam to each engine playing above the cylinders, as is customary, they have two, *reversed*—one each side of the cylinder, and moving close to the floor of the boat. The piston rods act upon a cross head, as in the common square engine; but the connecting rods, instead of leading directly to the cranks, are fastened to one end of the working beams below, and through them transmit the power by means of other connecting rods, to another cross head which is attached to the cranks; thus giving regular and continued motion to the entire machine. The grates and boilers are arranged expressly for burning bituminous coal, and her "bunkers" will contain from 10 to 1200 bushels.

The magazine occupies all the after part of the hold, under the cabins of the officers, and is in as secure a place as there is about the ship, being below the reach of shot, and out of the way of fire.

The *Minos* is schooner rigged, and shows a clean deck fore and aft; and were it not for her funnel and wheel-houses, would look like a large schooner, as she has no guards or upper works of any kind. She is expected to mount eighteen pound carronades and two mortars for shells in case of a bombardment.

The part of the vessel forward of the engines is fitted as a mess room for the "people," and is a very comfortable place, having short tables for each mess projecting from the sides of the boat, and shelves and lockers in abundance for accommodation of their traps. The main hold is underneath the "people's" mess, and will contain abundant room for stores for a long cruise.